

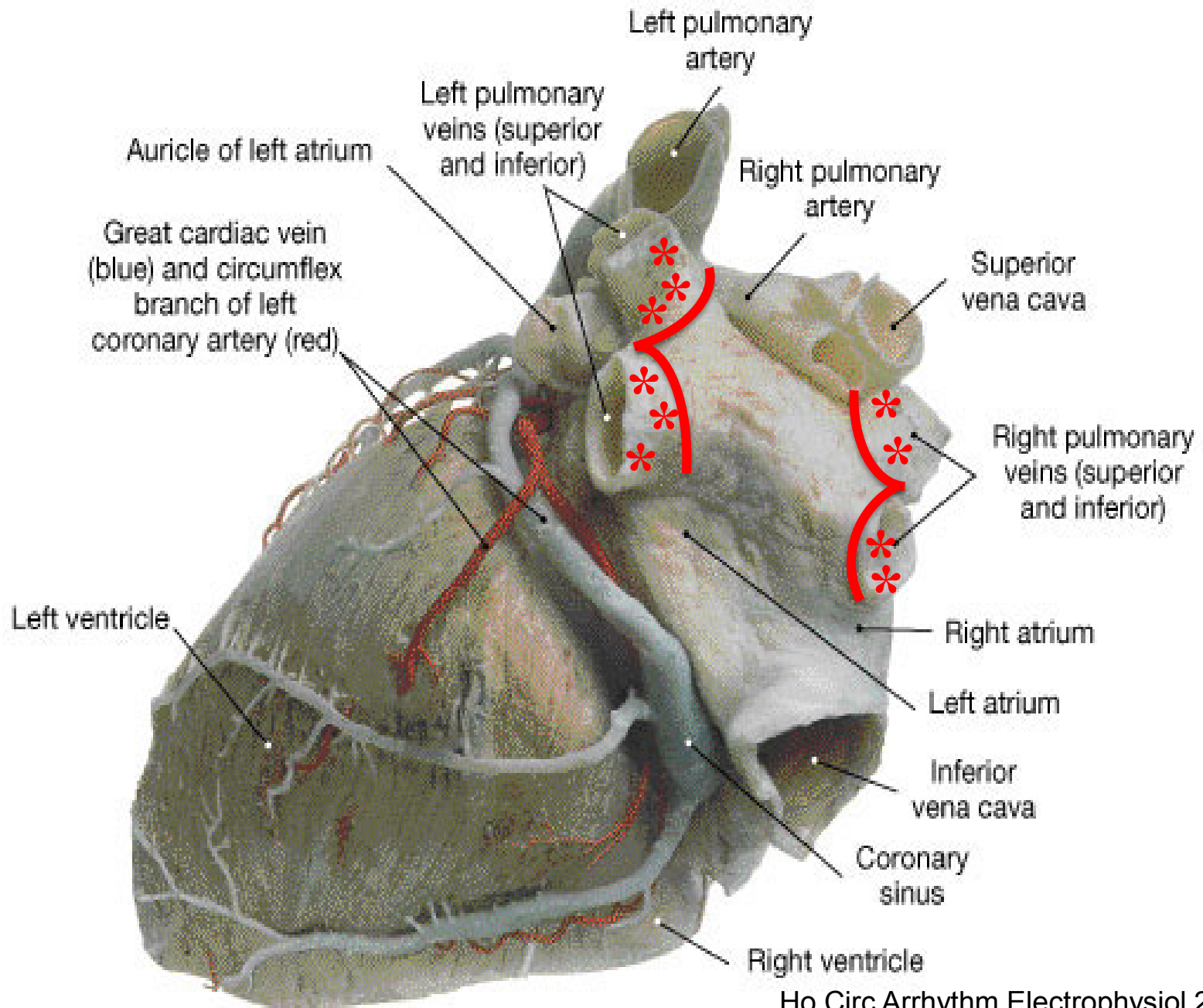
Advances in Cardiac Arrhythmias and Great Innovations in Cardiology  
Torino, 13/15 Ottobre 2016

**Cryoablation evolution:**  
from selected patients therapy to  
a new standard treatment  
for pulmonary veins isolation

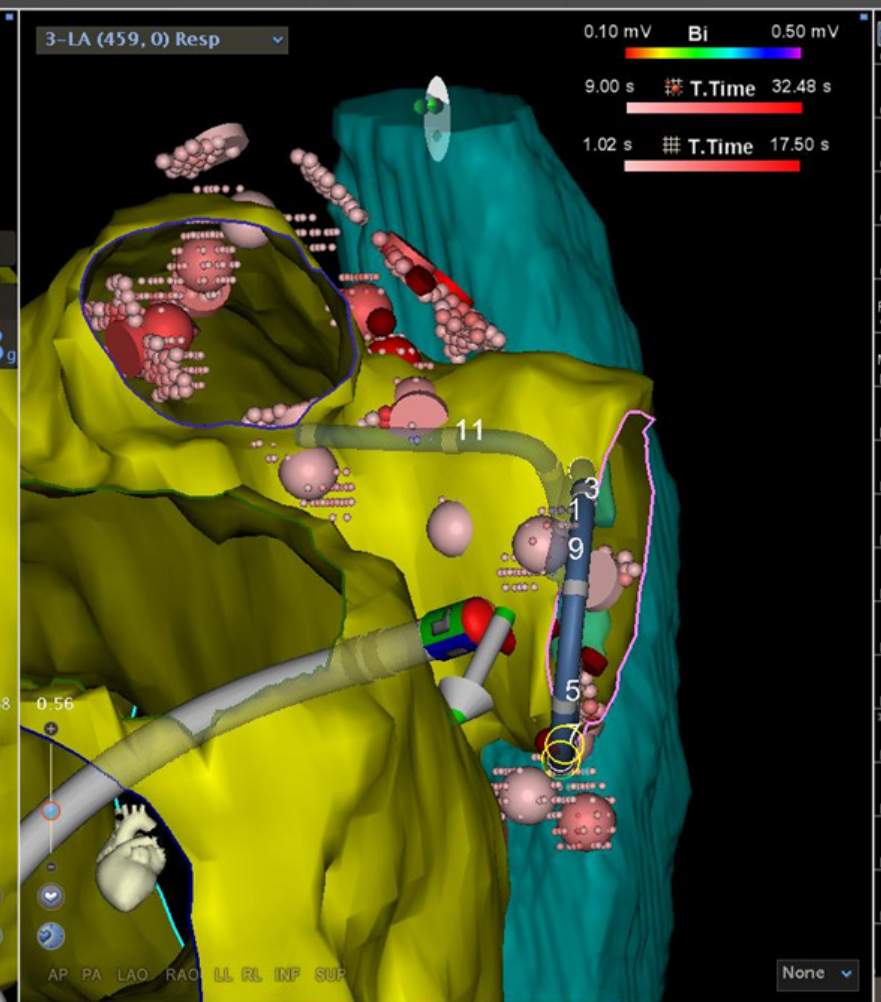


**Matteo Anselmino**  
Dipartimento Scienze Mediche  
“Città della Salute e della Scienza” Hospital  
University of Turin, Italy



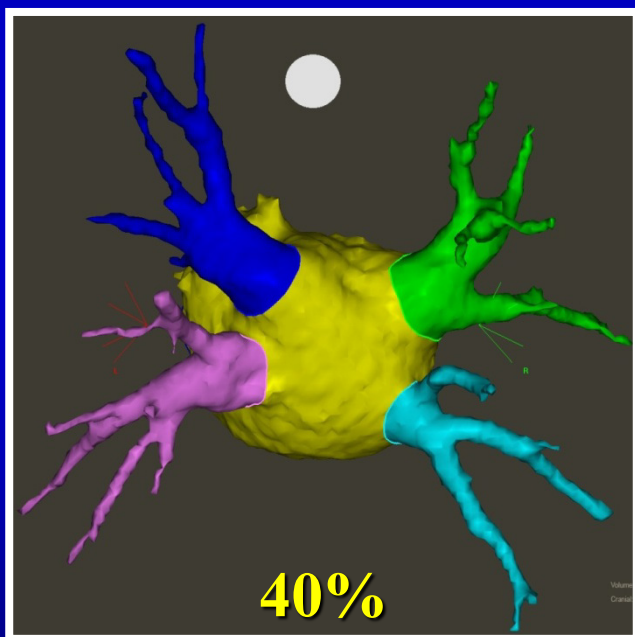


# Pulmonary vein isolation...but which tool?

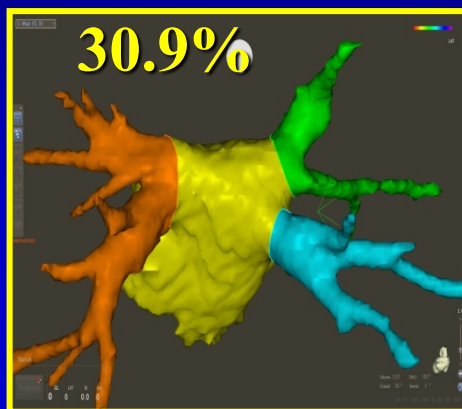


# Morphologic Analysis of Left Atrial Anatomy by Magnetic Resonance Angiography in Patients With Atrial Fibrillation: A Large Single Center Experience

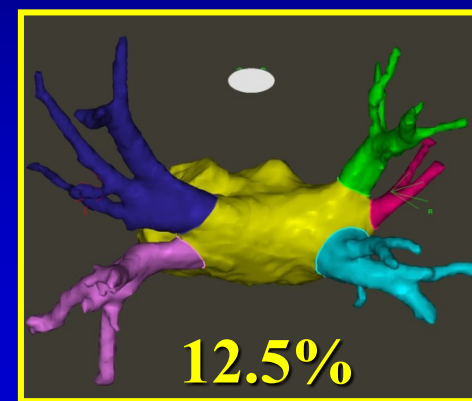
MATTEO ANSELMINO, M.D., Ph.D.,\* ALESSANDRO BLANDINO, M.D.,\*,†  
SERENA BENINATI, M.D.,\*,† CHIARA ROVERA, M.D.,\*,† CARLO BOFFANO, M.D.,‡  
MARCO BELLETTI, M.D.,‡ DOMENICO CAPONI, M.D.,† MARCO SCAGLIONE, M.D.,†  
FEDERICO CESARANI, M.D.,‡ and FIORENZO GAITA, M.D.,\*†



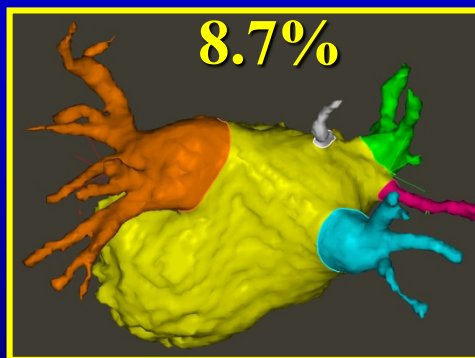
Typical Pattern  
(4 PVs)



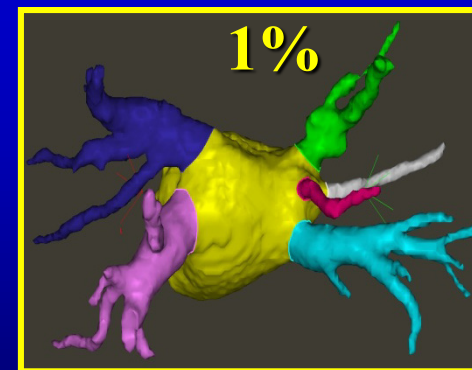
Common Left Trunk



Right middle PV



Common Left Trunk  
and middle RPV



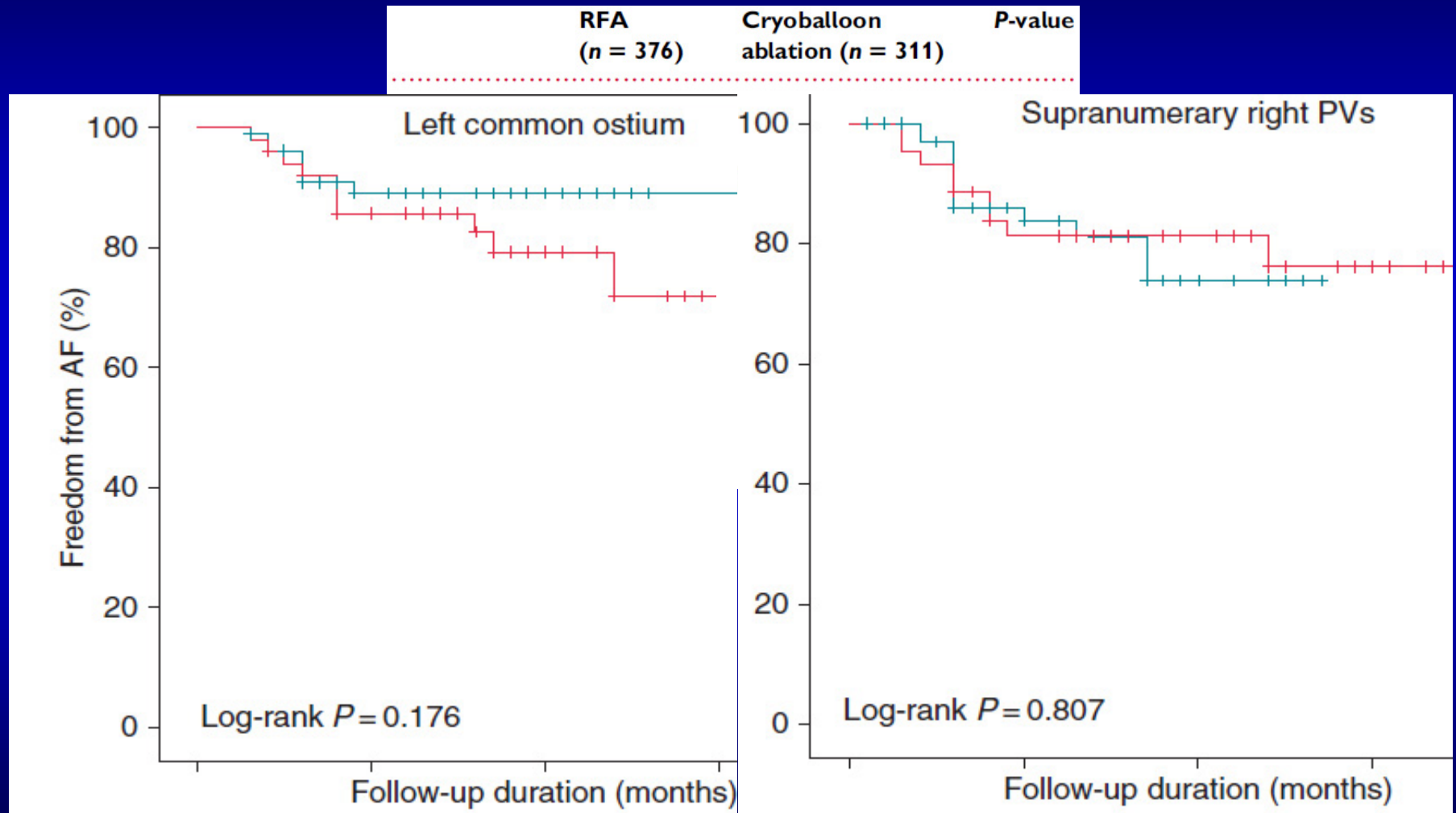
2 Right Middle PVs

# Relevance of PV encircling size

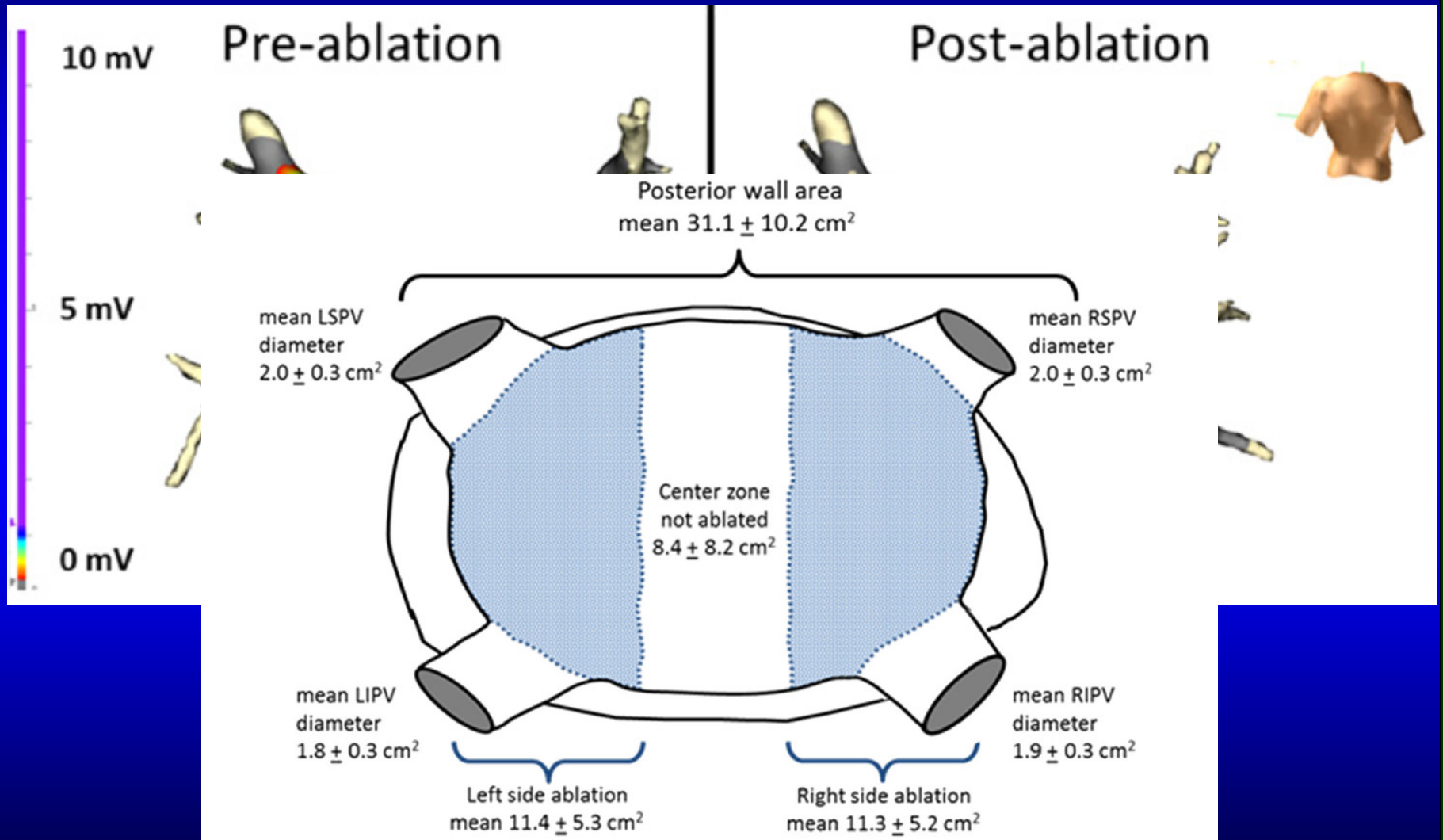
**Table 3. Clinical Outcomes, Abnormality of PV, Size of LA, Esophageal Course, and Procedural Data for Patients Grouped by ISA**

	All Patients (n=101)	Group I (n=23) ISA<50	Group II (n=23) ISA≥50	Group III (n=33) ISA≥60	Group IV (n=22) ISA≥70	<i>P</i>
ISA, %	59.2±11.6	42.8±4.2	54.2±3.0	64.3±3.0	73.9±3.6	
Procedure time, min	142±44	144±53	145±55	145±51	133±42	NS (0.79)
Fluoroscopy time, min	36±15	38±16	40±21	33±11	33±10	NS (0.22)
RF application time, min	34 (28–46)	34 (30–41)	35 (28–60)	34 (26–46)	30 (28–45)	NS (0.38)
RF energy, mean J (range)	71 465 (57 776–104 800)	71 436 (63 274–90 858)	85 096 (52 954–142 201)	69 851 (54 812–103 752)	64 934 (60 885–104 699)	NS (0.60)
Recurrence of AF/MRT, n (%)	13 (13)	7 (30)	5 (21)	1 (3)	0 (0)	

# Pulmonary veins...anatomy matters?



# Cryoballoon: PV extension



## **Comparison of Cryoballoon and Radiofrequency Ablation of Pulmonary Veins in 40 Patients with Paroxysmal Atrial Fibrillation: A Case-Control Study**

MARKUS LINHART, M.D., BARBARA BELLMANN, ERICA MITTMANN-BRAUN, M.D.,  
JAN W. SCHRICKEL, M.D., ALEXANDER BITZEN, M.D., RENÉ ANDRIÉ, M.D.,  
ALEXANDER YANG, M.D., GEORG NICKENIG, M.D., LARS LICKFETT, M.D.,  
and THORSTEN LEWALTER, M.D.

## **Cryoballoon Versus RF Ablation in Paroxysmal Atrial Fibrillation: Results from the German Ablation Registry**

MARTIN SCHMIDT, M.D.,\* UWE DORWARTH, M.D.,\* DIETRICH ANDRESEN, M.D.,†  
JOHANNES PRACHMANN, M.D.,‡ KARL HEINZ KUCK, M.D.,§ MALTE KUNISS, M.D.,¶  
THORSTEN L. JOCHEN SENGEL, M.D.,\*\*

## **Comparison of Pulmonary Vein Isolation Using Cryoballoon Versus Conventional Radiofrequency for Paroxysmal Atrial Fibrillation**

Giacomo Mugnai, MD<sup>a,b,\*</sup>, Gian-Battista Chierchia, MD, PhD<sup>a</sup>, Carlo de Asmundis, MD, PhD<sup>a</sup>,  
Juan Sieira-Moret, MD<sup>a</sup>, Giulio Conte, MD<sup>a</sup>, Lucio Capulzini, MD<sup>a</sup>, Kristel Wauters, MD<sup>a</sup>,  
Moises Rodriguez-Mañero, MD<sup>a</sup>, Giacomo Di Giovanni, MD<sup>a</sup>, Giannis Baltogiannis, MD<sup>a</sup>,  
ID, PhD<sup>a</sup>

## **Cryoballoon Versus Open Irrigated Radiofrequency Ablation in Patients With Paroxysmal Atrial Fibrillation**

**The Prospective, Randomized, Controlled, Noninferiority FreezeAF Study**

Armin Luik, MD; Andrea Radzewitz, PsyD; Meinhard Kieser, ScD; Marlene Walter;  
Peter Bramlage, MD; Patrick Hörmann, MD; Kerstin Schmidt, MD; Nicolas Horn, MD;  
Maria Brinkmeier-Theofanopoulou, MD; Kevin Kunzmann, MSc; Tobias Riexinger, MD;

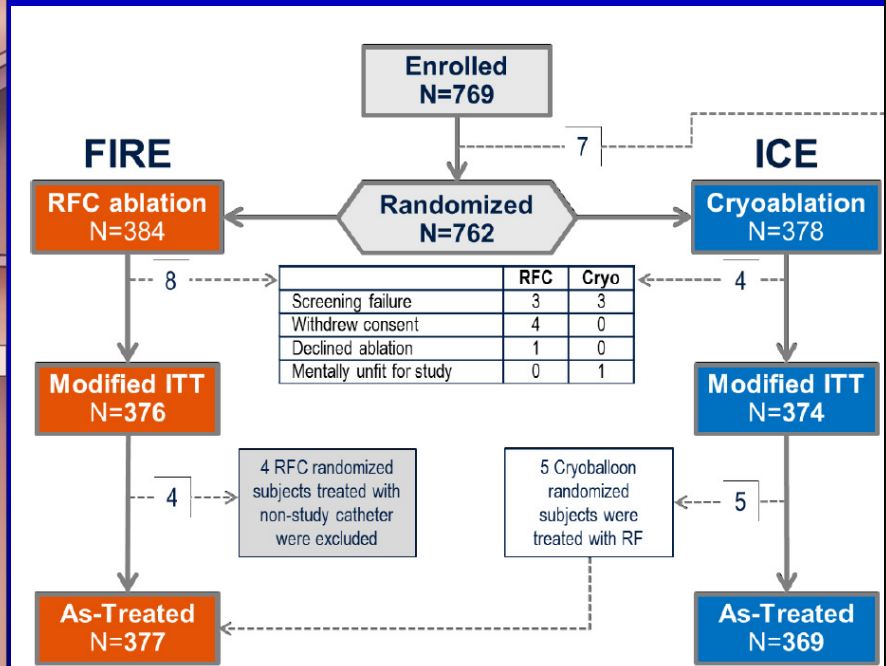
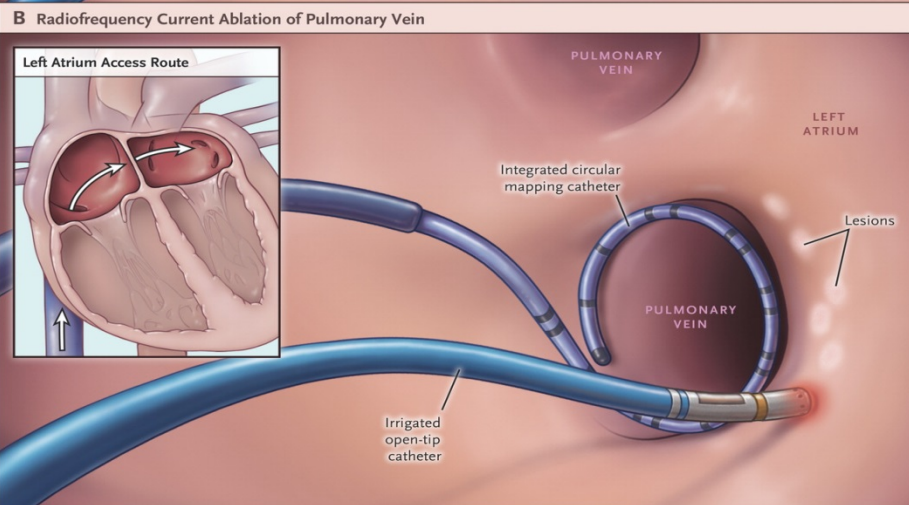
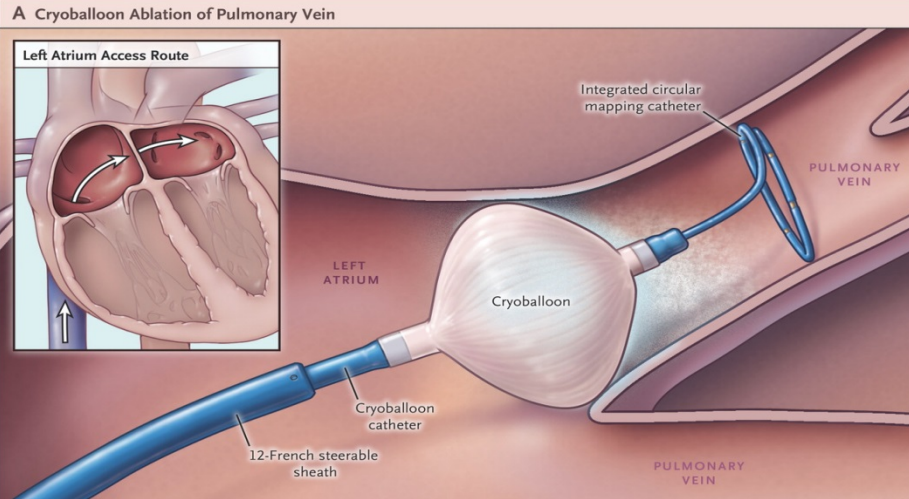
## **Is Cryoballoon Ablation Preferable to Radiofrequency Ablation for Treatment of Atrial Fibrillation by Pulmonary Vein Isolation? A Meta-Analysis**

Junxia Xu<sup>1,2\*</sup>, Yingqun Huang<sup>3</sup>, Hongbin Cai<sup>3</sup>, Yue Qi<sup>4</sup>, Nan Jia<sup>5</sup>, Weifeng Shen<sup>6</sup>, Jinxiu Lin<sup>3</sup>, Feng Peng<sup>3\*</sup>,  
Wenquan Niu<sup>7,8,9\*</sup>

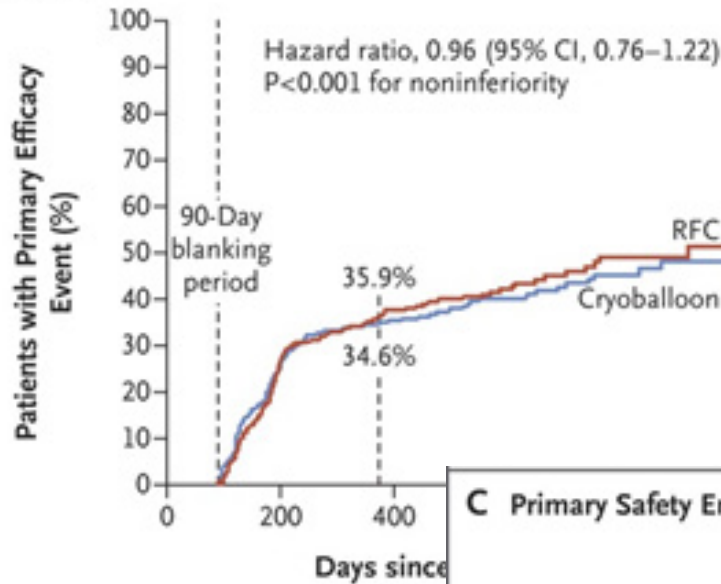


# Cryoballoon or Radiofrequency Ablation for Paroxysmal Atrial Fibrillation

Karl-Heinz Kuck, M.D., Josep Brugada, M.D., Alexander Fürnkranz, M.D., Andreas Metzner, M.D., Feifan Ouyang, M.D., K.R. Julian Chun, M.D., Arif Elvan, M.D., Ph.D, Thomas Arentz, M.D., Kurt Bestehorn, M.D., Stuart J. Pocock, Ph.D., Jean-Paul Albenque, M.D., Ph.D., and Claudio Tondo, M.D., Ph.D., for the FIRE AND ICE Investigators\*



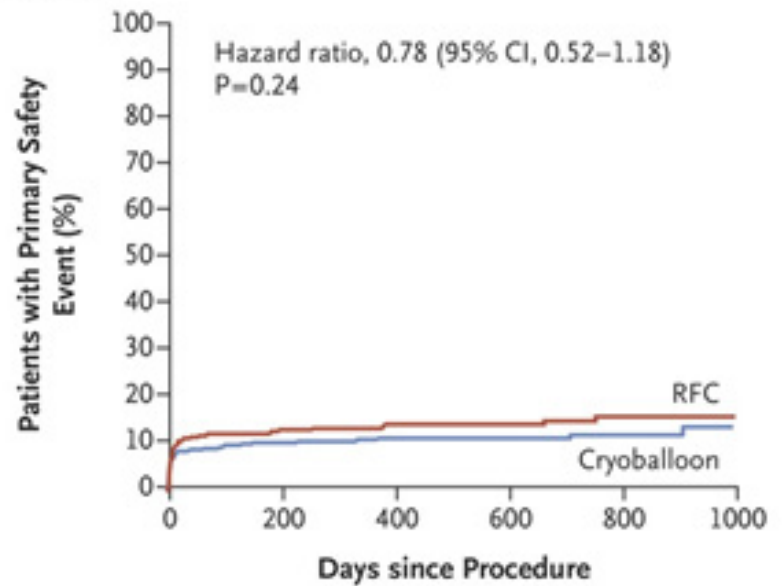
### A Primary Efficacy End Point



#### No. at Risk

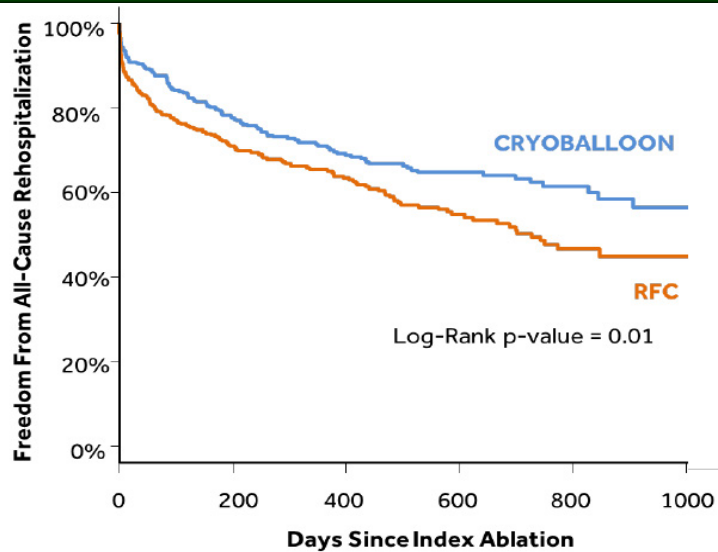
Cryoballoon	374	338	242	194	165	1
RFC	376	350	243	191	149	1

### C Primary Safety End Point



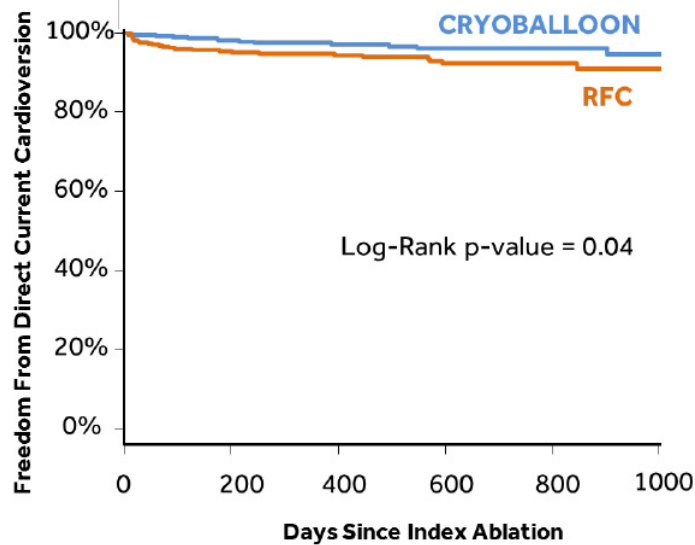
#### No. at Risk

Cryoballoon	374	323	298	261	229	189	159	117	94	55	21
RFC	376	315	292	247	215	176	146	110	87	52	27



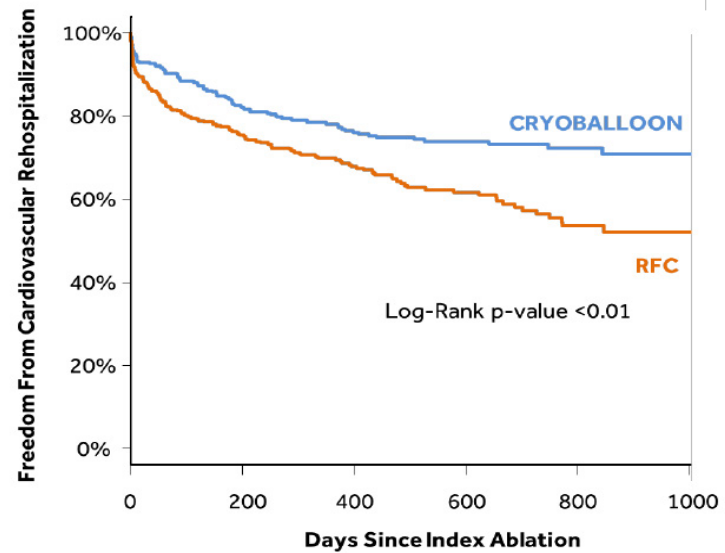
Number at Risk

CRYOBALLOON	374	257	174	113	56	13
RFC	376	235	157	90	43	10



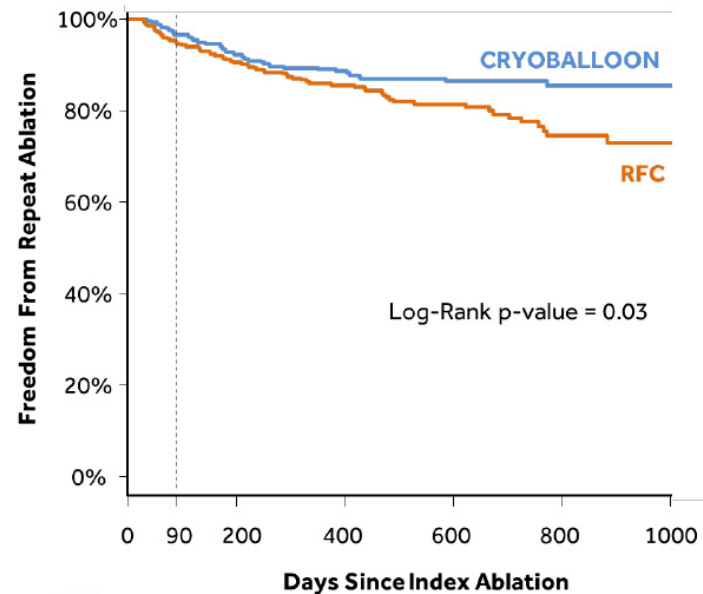
Number at Risk

CRYOBALLOON	374	321	247	170	100	24
RFC	376	320	235	162	96	30



Number at Risk

CRYOBALLOON	374	271	190	126	68	15
RFC	376	250	167	102	52	14



Number at Risk

CRYOBALLOON	374	343	301	221	149	84	20
RFC	376	341	302	213	135	72	22

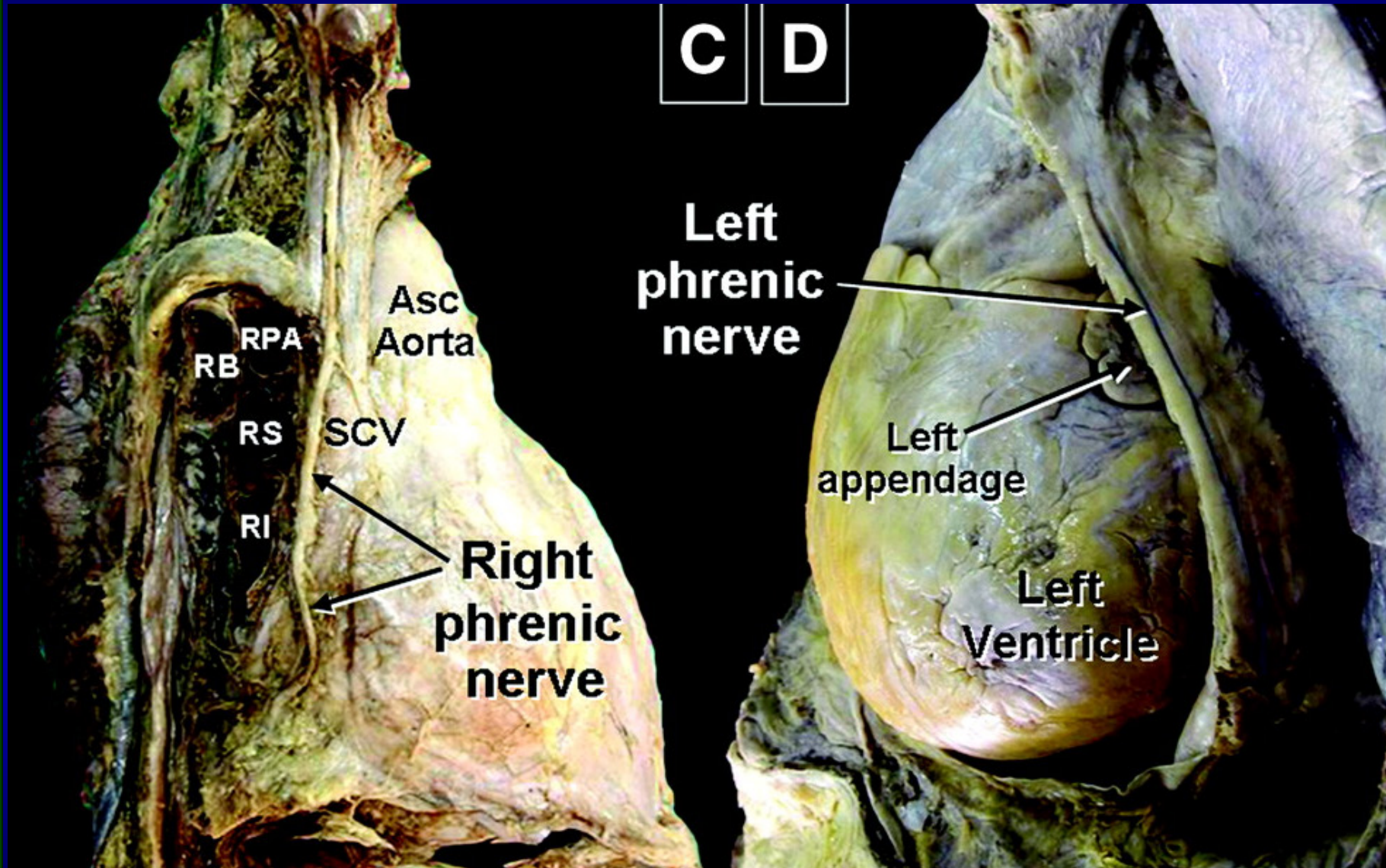
**Table 2. Efficacy End Points.\***

End Point	Radiofrequency Group (N=376)	Cryoballoon Group (N=374)	Hazard Ratio (95% CI)†	P Value
Primary efficacy end point — no. of patients (%)‡	143 (35.9)§	138 (34.6)§	0.96 (0.76–1.22)	<0.001¶
Components of the primary efficacy end point — no. of patients				
Recurrent atrial arrhythmia	87	80	—	—
Antiarrhythmic drug treatment	49	51	—	—
Repeat ablation	7	7	—	—
Secondary efficacy end points				
Death from any cause — no. of patients	0	2	—	0.25**
Death from arrhythmia — no. of patients	0	0	—	—
Total procedure duration — min	140.9±54.9	124.4±39.0	—	<0.001††
Left atrial dwell time — min‡‡	108.6±44.9	92.3±31.4	—	<0.001††
Total fluoroscopy time — min§§	16.6±17.8	21.7±13.9	—	<0.001††
Rehospitalization for cardiovascular causes — no. of patients (%)	55 (13.5)§	44 (9.4)§	0.78 (0.53–1.16)	0.28**

**Table 3. Safety End Points.**

End Point	Radiofrequency Group (N=376)	Cryoballoon Group (N=374)	P Value*
<i>no. of patients (%)</i>			
Primary safety end point†	51 (12.8)‡	40 (10.2)‡	
Death from any cause§	0	2 (0.5)¶	0.50
Stroke or TIA from any cause§	2 (0.5)	2 (0.5)	1.00
Atrial arrhythmia§	13 (3.5)	8 (2.1)	0.38
Atrial flutter or atrial tachycardia	10 (2.7)	3 (0.8)	0.09
Non-arrhythmia-related serious adverse events§	36 (9.6)	28 (7.5)	0.36
Groin-site complication**	16 (4.3)	7 (1.9)	0.09
Unresolved phrenic nerve injury††			
At discharge	0	10 (2.7)	0.001
At 3 months	0	2 (0.5)	0.25
At >12 months	0	1 (0.3)	0.50

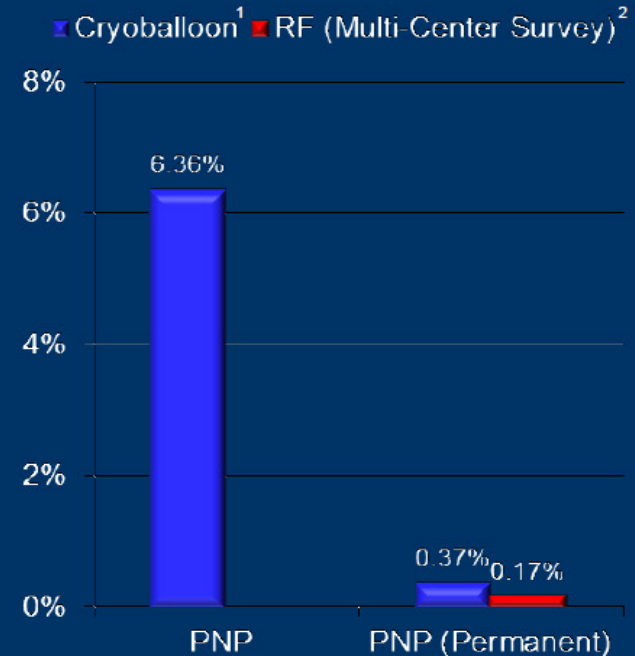
# Phrenic nerve injury



# Meta-Analysis of Phrenic Nerve Palsy from a Systematic Review of Published Studies with Arctic Front

539 Arctic Front articles screened, 23 were retained for the final analysis (1309 patients):

- PNP overall incidence of **6.38%**
  - **4.73%** of PNP persisted after the ablation procedure
  - **0.37%** of patients experiencing **PNP that persisted beyond 1 year.**

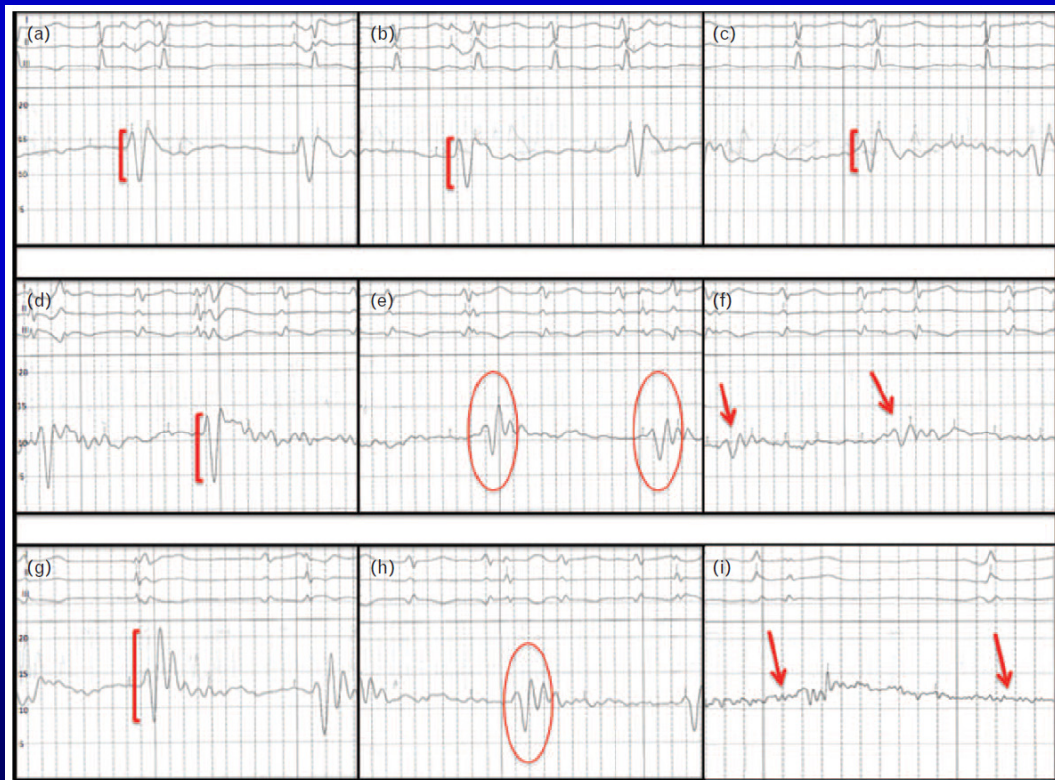


<sup>1</sup> Andrade, et al. Heart Rhythm 2011;8(9):1444-51, <sup>2</sup> Cappato et al. Circ Arrhythm Electrophysiol 2010;3:32-38

# Methods to minimize PNI

## Fluoroscopy of Spontaneous Breathing is More Sensitive Than Phrenic Nerve Stimulation for Detection of Right Phrenic Nerve Injury During Cryoballoon Ablation of Atrial Fibrillation

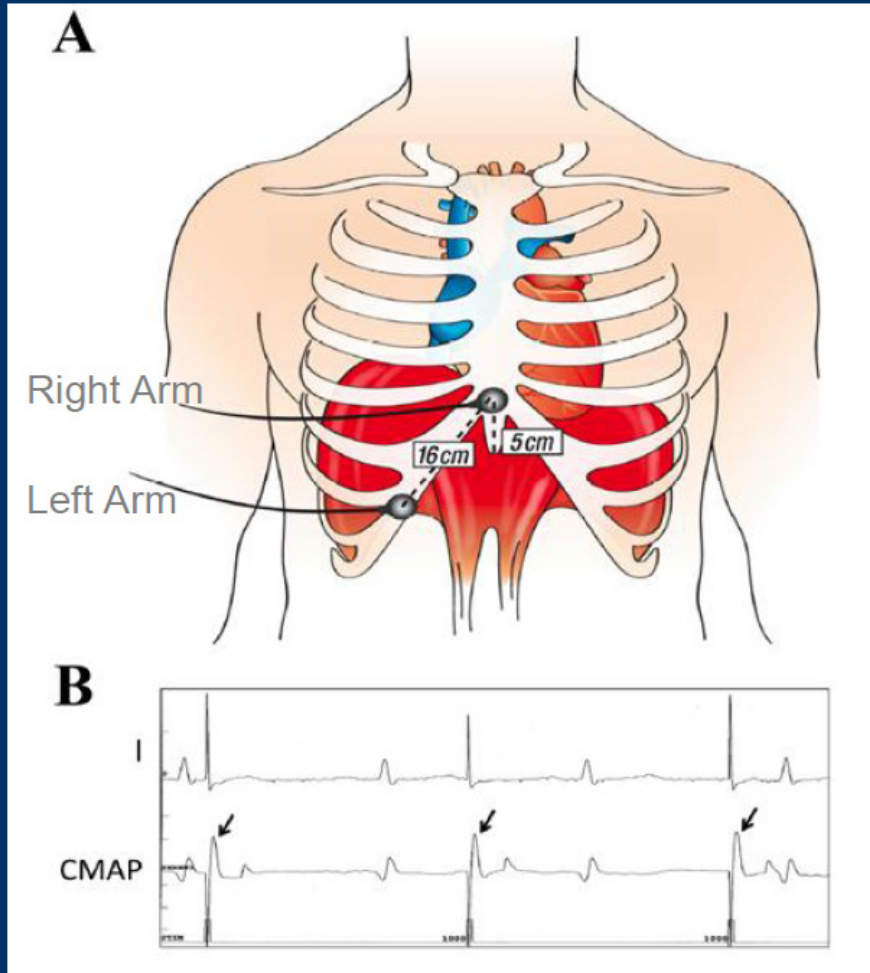
MARKUS LINHART, M.D., ANNIKA NIELSON, RENÉ P. ANDRIÉ, M.D.,  
ERICA L. MITTMANN-BRAUN, M.D., FLORIAN STÖCKIGT, M.D., JENS KREUZ, M.D.,  
GEORG NICKENIG, M.D., JAN W. SCHRICKEL, M.D., and LARS M. LICKFETT, M.D.



**Traditional** (n=200) vs  
**Femoral venous pressure**  
waveform monitoring (n=150)

**18 (9.0%)** phrenic palsies  
vs **2 (1.3%)** P=0.002

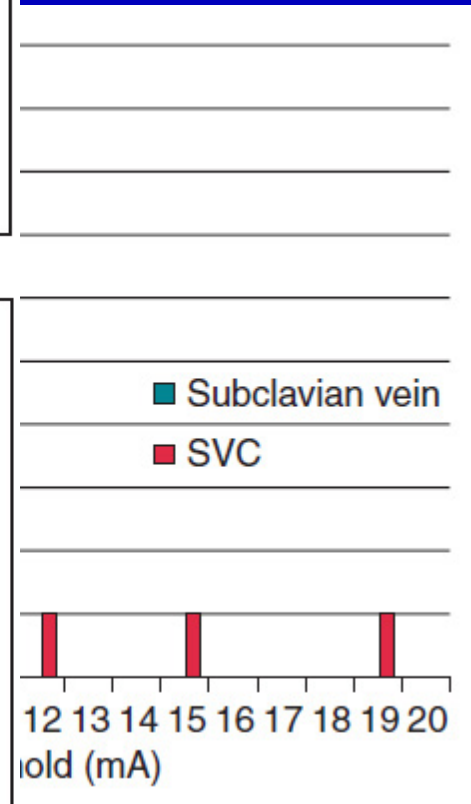
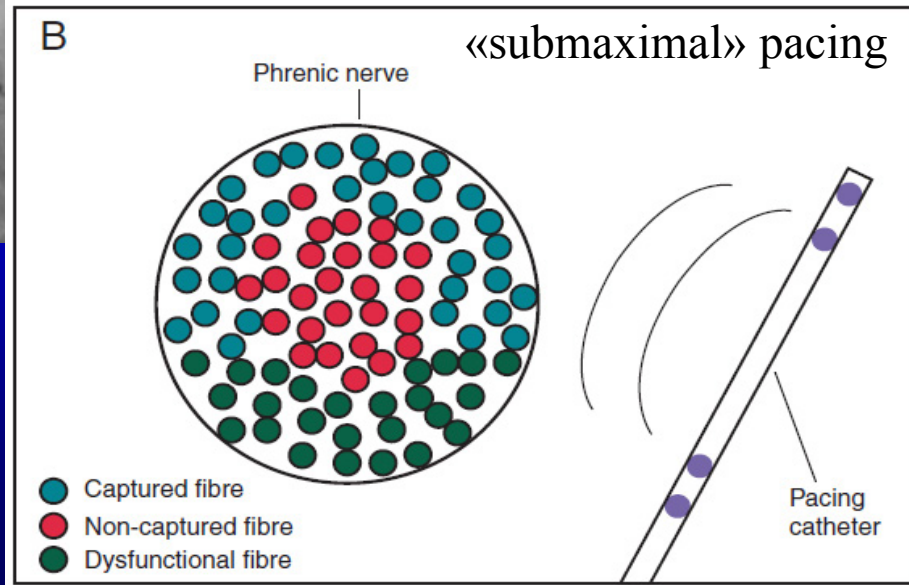
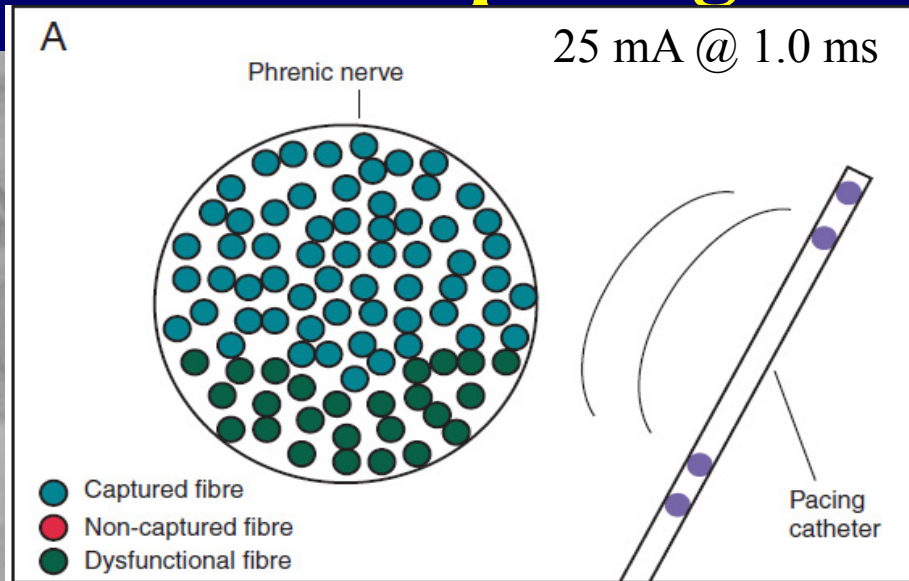
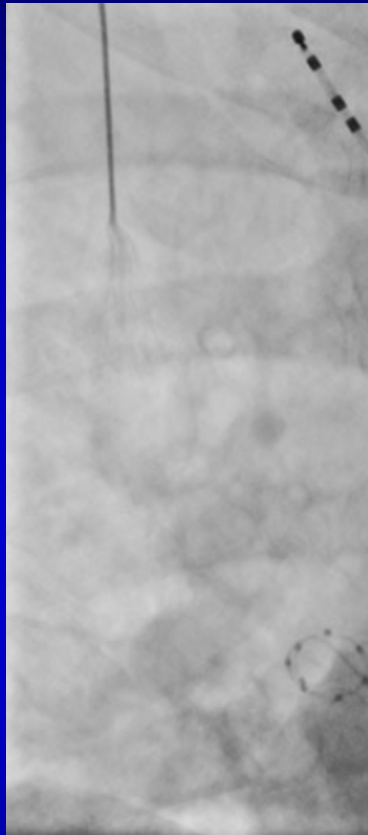
# CMAP Setup



- Use surface ECG leads Right Arm and Left Arm (lead I) or 2 additional surface electrodes
- Place recording electrode (Right Arm) 5 cm superior to the tip of the xiphoid process and reference electrode (Left Arm) 16 cm away, along the costal margin
- Increase gain on the recording system
- A horizontal caliper may help to recognize amplitude reduction

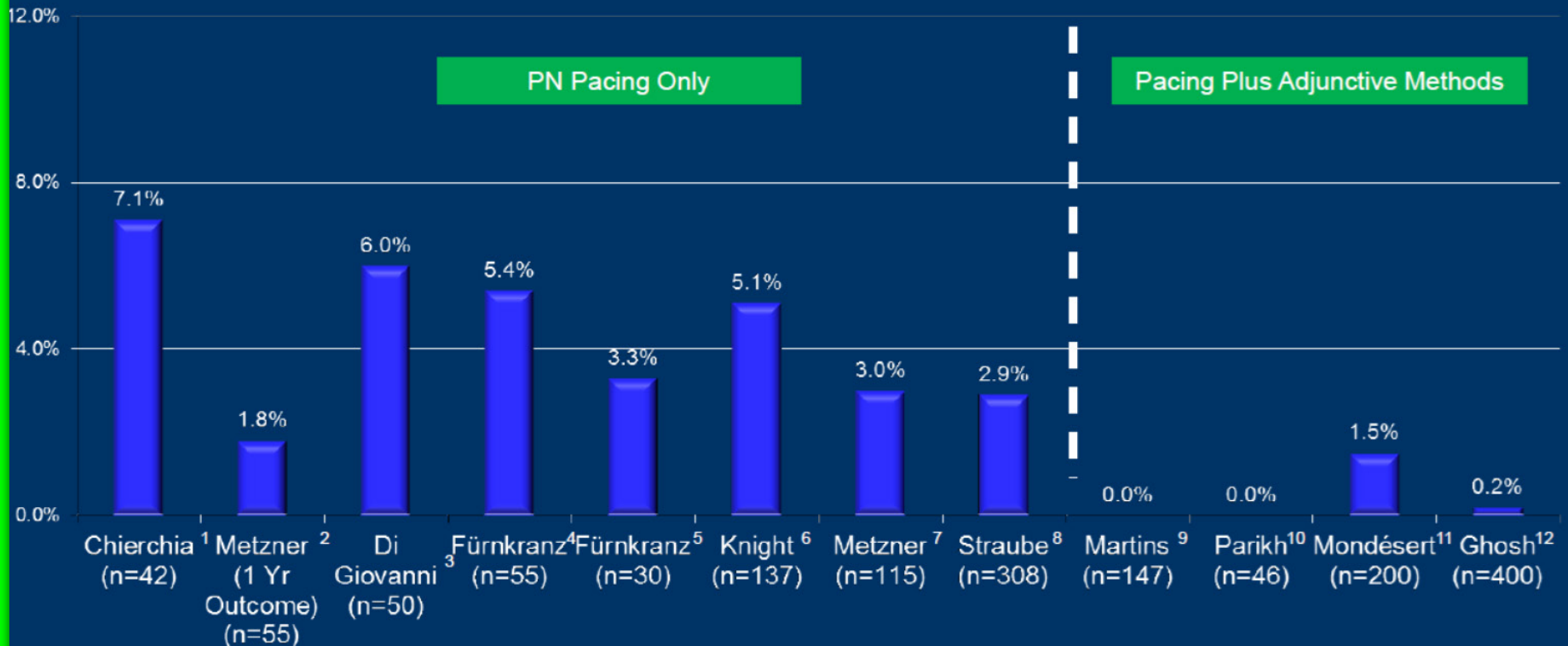


# Subclavian vein pacing at threshold



# Summary of Reported Rates of Phrenic Nerve Palsy with Arctic Front Advance

% PNP Not Resolved by End of Procedure or Point of Discharge



<sup>1</sup>Chierchia, et al. Europace 2014;16(5):639-44, <sup>2</sup>Metzner, et al. Circ Arrhythm Electrophysiol 2014 7(2):288-92, <sup>3</sup>Di Giovanni, et al. J Cardiovasc Electrophysiol 2014 In Press, <sup>4</sup>Fürnkranz, et al. J Cardiovasc Electrophysiol 2014 In Press, <sup>5</sup>Fürnkranz, et al. J Cardiovasc Electrophysiol J Cardiovasc 2013 May;24(5):492-7, <sup>6</sup>Knight, et al. HRS 2014 Abstract PO03-65, <sup>7</sup>Metzner, et al. J Cardiovas Electrophysiol 2014;25(5):466-70, <sup>8</sup> Straube, et al. Europace 2014 In Press, <sup>9</sup> Martins, et al. Hear Rhythm 2014;11(3):386-93, <sup>10</sup>Parikh, et al. HRS 2014 Abstract PO04-114, <sup>11</sup> Mondésert, et al. Circ Arrhythm Electrophysiol 2014, In Press, <sup>12</sup> Ghosh, et al. Cardioslim 2014 Abstract #176/65

**The New York Times** 30 Jan, 2014

# We Are Giving Ourselves Cancer

By RITA F. REDBERG M.D. 30, 2014



Ben Jones

# **AF Cryoballoon ablation**

**Città della Salute e della Scienza – Prof. Gaita**

*Thanks for your attention!*

